Homework 2

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1 Page 69: problem 12

From this vague scenario, identify a problem you would like to study. Which variables affect the behavior you have identified in the problem identification? Which variables are the most important?

A company with a fleet of trucks faces increasing maintenance costs as the age and mileage of the trucks increase.

A problem that would be interesting to study is the at what point should the truck be retired and a new vehicle purchased. The costs associated with a new purchase would need to outweigh the cost of maintaining the aged truck. The variables of importance would be the maintenance cost as its associated with the age and mileage of the truck, any additional variables such as the severity of past repairs. I would assume that a vehicle with engine failure may have future issues until the engine is replaced, at which point the cost of maintenance may not be as severe. Additionally, the cost of a new purchase would be the continuing payments, depreciation, maintenance, fuel efficiency, and the opportunity costs of reliability. The equilibrium of this system would be meaningful to make a data driven decision to buy a new vehicle or to keep running the aged truck.

2 Page 79: problem 11

Determine whether the data set supports the stated proportionality model.

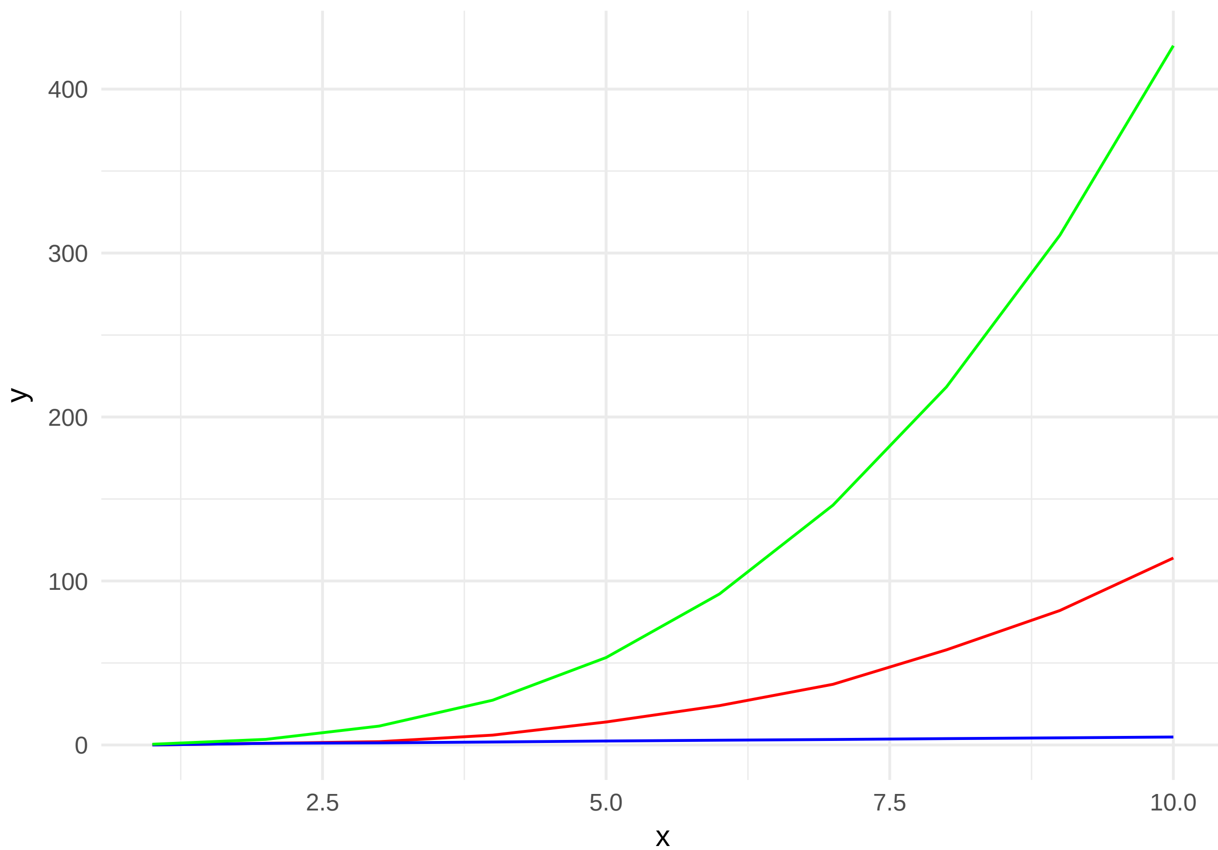
$$y \propto x^3$$

Table 1:

y	0	1	2	6	14	24	37	58	82	114
x	1	2	3	4	5	6	7	8	9	10

```
library(ggplot2)
y <- c(0, 1, 2, 6, 14, 24, 37, 58, 82, 114)
x <- c(1:10)
df <- as.data.frame(cbind(y,x))
df$y2 <- df$y^(1/3)
df$k <- df$y2/df$x
k <- mean(df$k)
df$model <- k*df$x^3

ggplot() +
  geom_line(data = df, aes(x, y), color = 'red') +
  geom_line(data = df, aes(x,y2), color = 'blue') +
  geom_line(data = df, aes(x,model), color = 'green') +
  theme_minimal()
```



The data does not support the proportion modelsince our data does not pass through the origin (0,0) and our slope is small comparitive to 1. Our used model for this data is $y = .426x^3$ where $k = .426$. This is achieved by taking $y^{\frac{1}{3}}$ and from the values in our provided data set. Then we obtain the ratio of $\frac{y^{\frac{1}{3}}}{x}$ and further obtain the mean which is $.426$. As illustrated above the model illustrates that the data does not follow the proportional model.

3 Page 94: problem 4

Lumber Cutters - Lumber cutters wish to use readily available measurements to estimate the number of board feet for lumber in a tree. Assume they measure the diameter of the tree in inches at waist height. Develop a model that predicts board feet as a function of diameter in inches.

Use the following data for your test.

Table 2:

x	17	19	20	23	25	28	32	38	39	41
y	19	25	32	57	71	113	123	252	259	294

```
x <- c(17,19,20,23,25,28,32,39,41)
y <- c(19,25,32,57,71,113,123,252,259,294)
df <- cbind(x,y)
```

```
## Warning in cbind(x, y): number of rows of result is not a multiple of
## vector length (arg 1)
```

The variable x is the diameter of a ponderous pine in inches, and y is the number of board feet divided by 10.

a. Consider two separate assumptions, allowing each to lead to a model. Completely analyze each model.
b. Assume that all trees are right-circular cylinders and are approximately the same height.

```
df$y2 <- df$x^3
df$k <- df$y2/df$x
k <- mean(df$k)
df$model <- k*df$x^3
```

ii. Assume that all trees are right-circular cylinders and that the height of the tree is proportional to the diameter.

b. Which model appears to be better? Why? Justify your conclusions.

4 Page 99: problem 3

Discuss several factors that were completely ignored in our analysis of the gasoline mileage problem.

5 Page 104: problem 2

Tests exist to measure the percentage of body fat. Assume that such tests are accurate and that a great many carefully collected data are available. You may specify any other statistic, such as waist size and height, that you would like collected. Explain how the data could be arranged to check the assumptions underlying the sub models in this section. For example, suppose the data for males between ages 17 and

21 with constant body fat and height are examined. Explain how the assumption of constant density of the inner core could be checked.